Space Weather Technical Forecast

Issued on Tuesday, 11 April 2023 at 00:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one M2.8 flare from AR3276 on the southeast limb, peaking at 10/0520 UTC and a number of C-flares. This region is gradually rotating into view, but currently consists of two small spots and surrounding plage although further details may become apparent as it rotates into view. AR3272 is the largest spot on the disc, situated in the southeast quadrant. This consists of a large number of individual small spots, with ongoing development, and some slight magnetic complexity. There are three other sunspot regions currently on the disc, however these are smaller and simpler but with a general growth trend.

There are no Earth-directed CMEs, with no ejection observed in available imagery from the filament eruption in the northeast disc around 10/0600 UTC.

Solar Wind / Geomagnetic Activity: An ongoing weak transient was followed by a transition into the fast wind of CH91/+. The speed was initially slow at below 350km/s, rising from 10/0600 UTC to reach 480-550km/s by 10/0845 UTC. Density was mostly at background, but above average between 10/0300-0630 peaking 38 ppcc. The total IMF, Bt, was Moderate at first, rising to peak 14nt by 0800 UTC, then easing vary at weak to moderate levels generally between 6-10nT from 06/1200 UTC. The north-south component, Bz, was moderately negative (southward) at first, with minimum -8 nT, but rotated to be mostly positive (northward) from 10/0720 UTC, peaking around 10nT. The phi angle was initially negative (towards the Sun) but rotated to be mainly positive from 10/0900 UTC. Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, was at background. The high energy electron flux (greater than 2MeV), as measured at GOES16 was at background levels. The associated 24 hour fluence was below the Active threshold with a declining trend. The 11/0000 UTC observed fluence was 1.84e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate, with a chance of further isolated M-flares. AR3272 and AR3276 are the most likely sources of activity.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, although there is with a low possibility of a glancing arrival from a CME which let the Sun on the 7 Apr, either late day 1 or early day 2 (11 or 12 Apr). Ongoing slightly elevated winds are expected, with further coronal hole sourced enhancements possible, however any geomagnetic activity is likely to remain limited. Mainly Quiet activity expected with a chance of Unsettled intervals and a very slight chance of Active if any CME arrival occurs.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy (greater than 2 MeV) electron flux is expected to remain at mainly background with the associated 24 hour fluence remaining below

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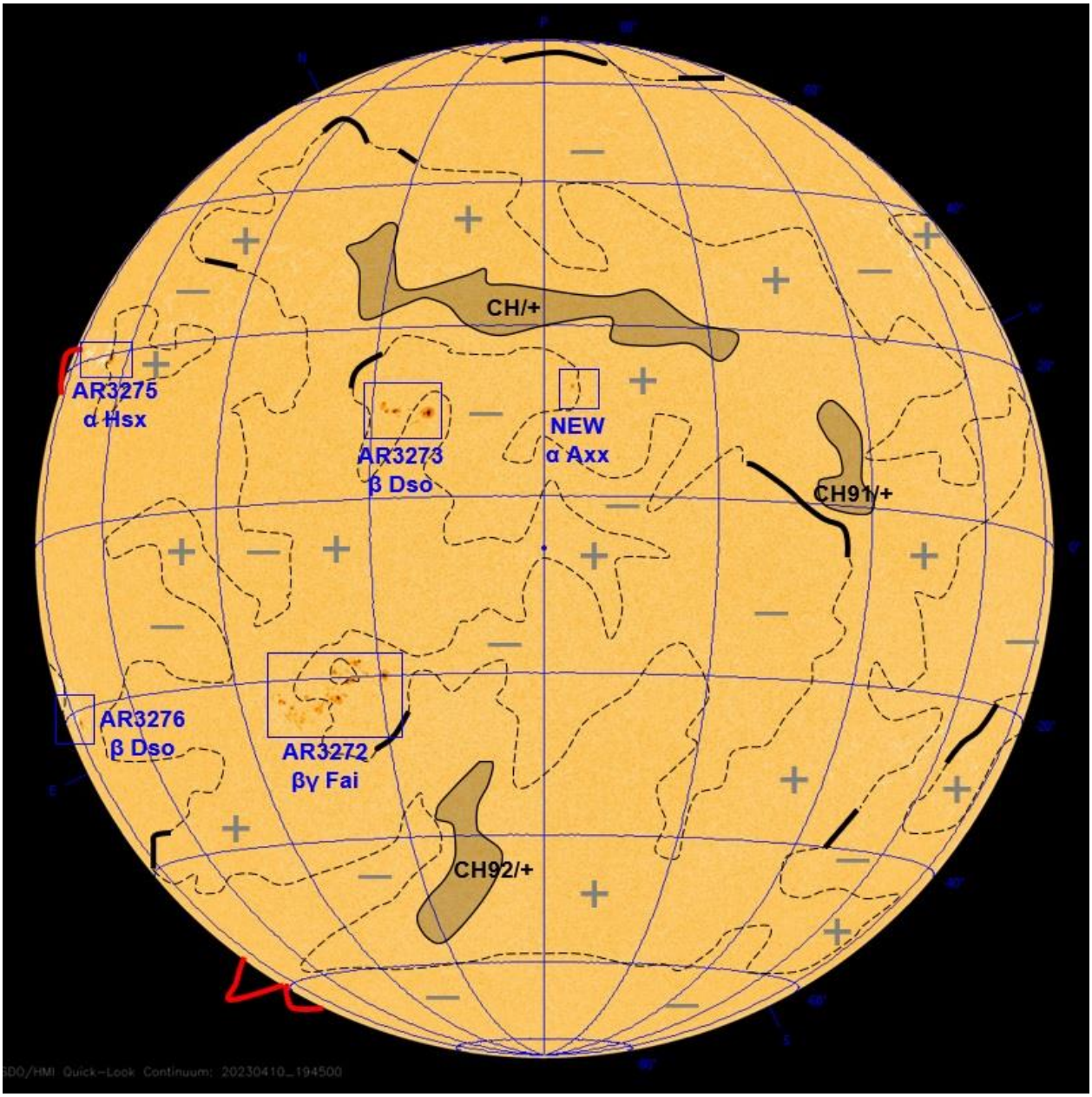
the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 10/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs. Although there is a slight chance of a glancing interaction either late day 1 or early day 2 (11/12 Apr) due to a CME from 07 Apr. This is most likely miss however, passing south and ahead of Earth's position

Earth is currently in fast wind conditions, associated with the HSS of CH91/+ which arrived 10 Apr. The longevity of these winds is low confidence as the fast wind enhancement is missing from Enlil, while the 27-day persistence is contaminated by the arrival of a CME on the last rotation. Furthermore, a latitudinally narrow, but longitudinally broad coronal hole is situated across the northern disc, albeit largely obscured by the looping on the disc. In enlil its associated fast wind can be seen passing above the Earth, only fading away on day 4 (14 Apr). A further southern coronal hole (CH92/+) may also give an enhancement on day 4 (14th).

These feature give a potential for Earth to see slightly elevated winds throughout the period however due to their positive polarity and the time of year, any geomagnetic enhancement is expected to remain subdued (Russell-McPherron effect). Mainly Quiet conditions are expected throughout, with isolated Unsettled spells and only a slight chance of Active intervals, mainly on day 1 or 2 (Apr 11 and 12) due to any slight CME glance that may occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/0810	Partial	Filament	SW	388	Missing	Low chance of glance late 11th or 12th

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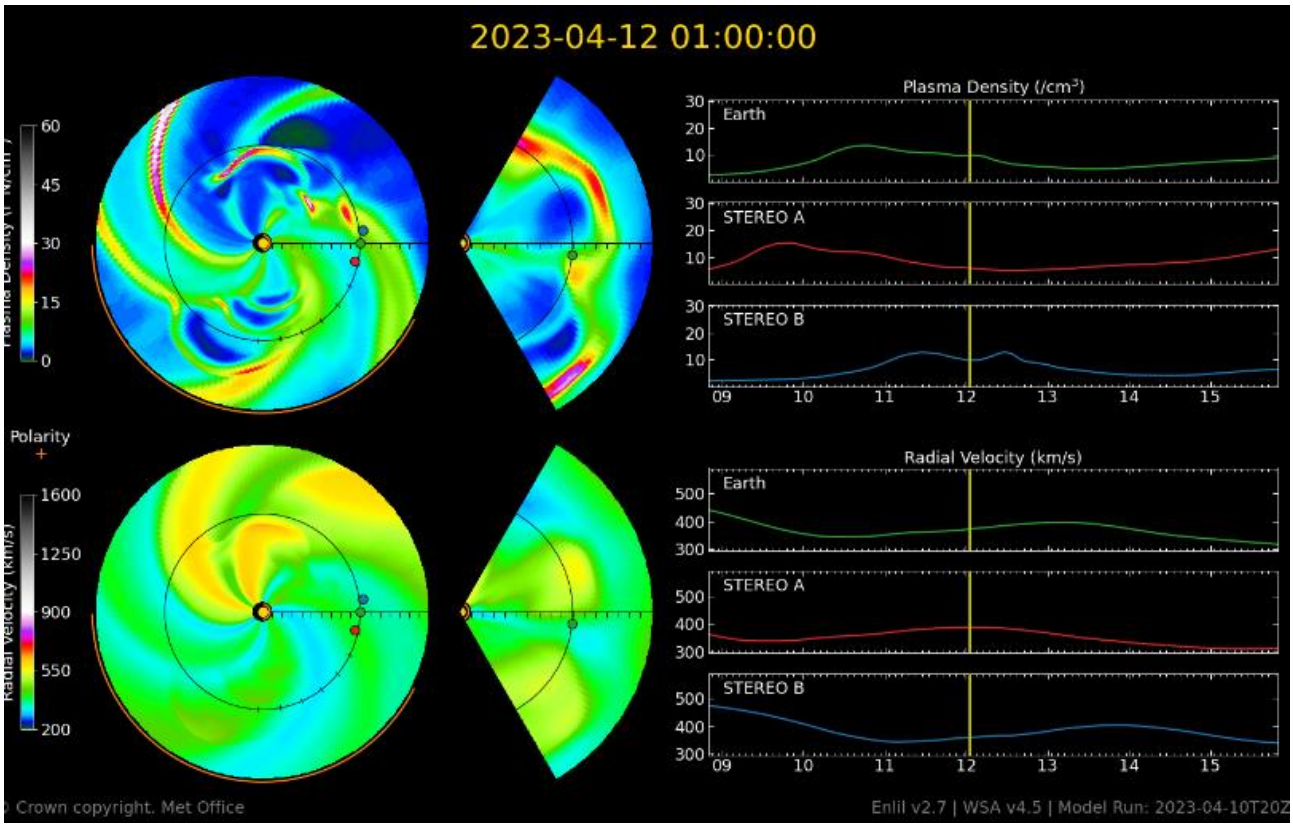
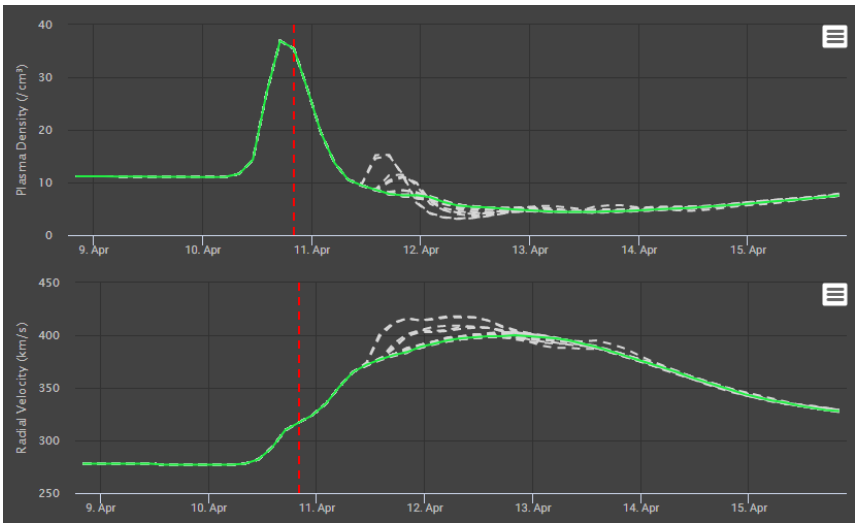
Figure 2: Enlil showing possible glancing CME in ensemble, but largely missing in control run as shown below. Can see fast wind region also passing above the Earth, but this is likely to have a stronger connection.





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Radio Blackouts - X-Ray Flares:

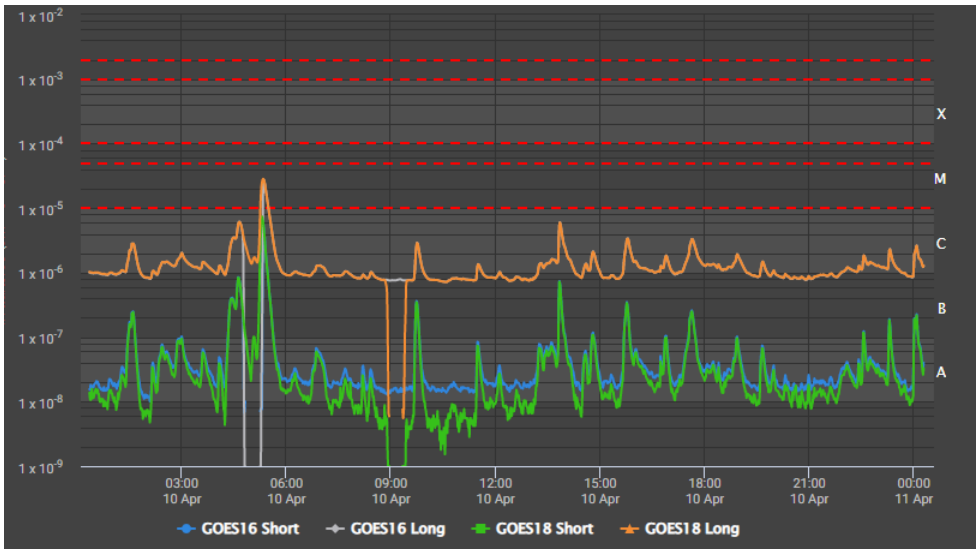
Low to Moderate activity is expected to continue with the ongoing chance of isolated M-flares.

There are two sunspots which have a history of M-flaring, along with frequent low level C-flares. AR3272 is a moderately sized region in the southeast quadrant, albeit comprised of multiple small spots, and only very limited magnetic complexity due to a couple of small reverse polarity spots near the main negative leaders. Ongoing development of this region is likely as it continues to mature. AR3276, however, is more difficult to assess, as it has only recently rotated into view from around the southeast disc. On the far-side this was a source of a number of CMEs, and it has a bright appearance in SDO aia-94. Despite this, only very small spots are currently visible along with nearby faculae. More complexity may become apparent over the coming days as it moves into a less oblique viewing angle.

Further regions are also present on the disc, with AR3273 also showing some notable growth, although this has a simple bipolar magnetic structure. Along with a few further smaller spots, there is a current trend to increasing activity and further sunspot develop appears likely.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16/18 X-ray Flux



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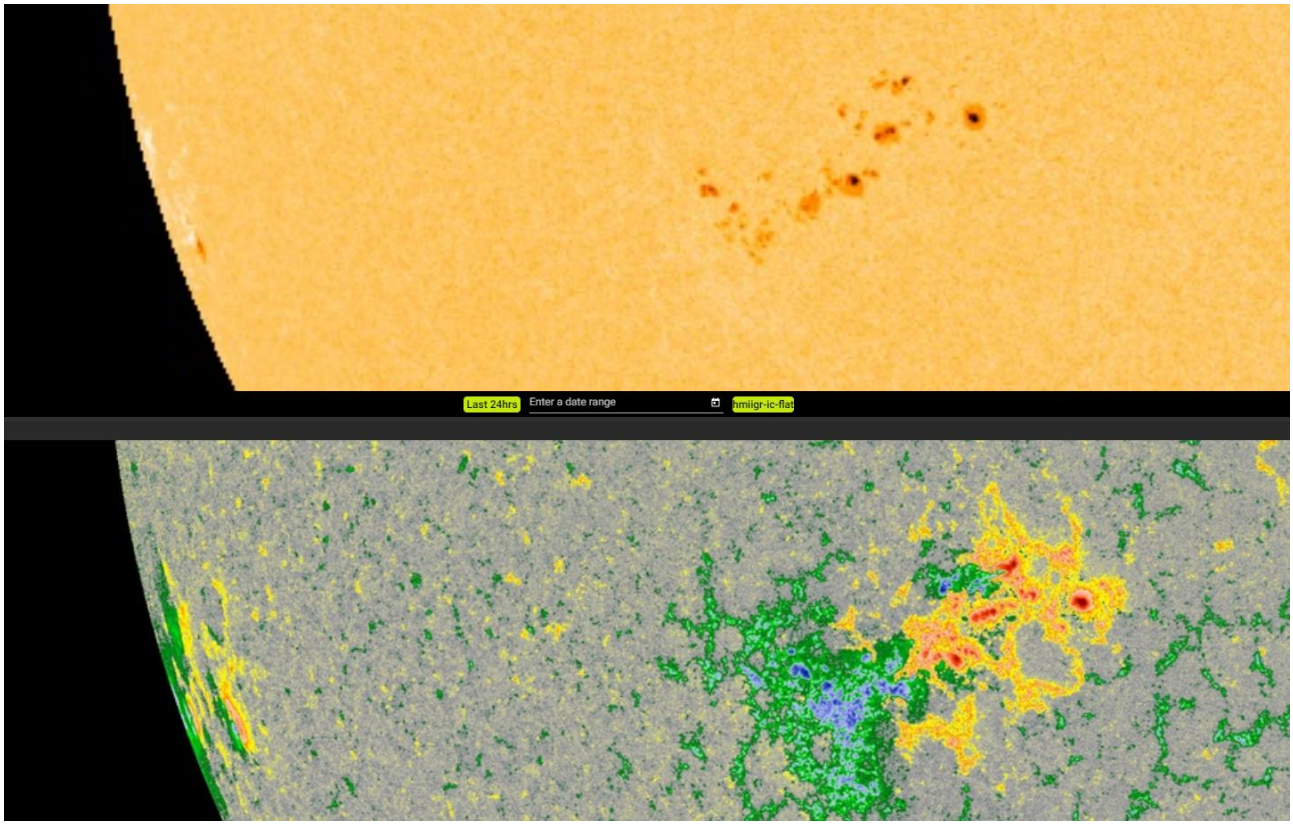
Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is likely to remain at background levels through the period. The majority of the sunspots on the disc are in the eastern hemisphere and currently unlikely to produce to strong flares, however there is a very slightly increased risk late in the period as these, including AR3272 rotate into the western disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO hmi-intensitygram and magnetogram of AR3272 (right) and AR3276 (left) in SE disc.



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High Energy Electrons Event (≥ 2MeV):

The High energy (greater than 2 MeV) electron flux is at background and unlikely to rise significant due to the current observed solar wind enhancements. Peak diurnal values may reach moderate levels by the end of the period, but otherwise are expected to persist at mainly background.

The associated 24 hour fluence is expected to be below the Active (1e8 integrated pfu) threshold with REFM expected to give good guidance through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES 16 >2MeV electron flux and fluence with REFM

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